

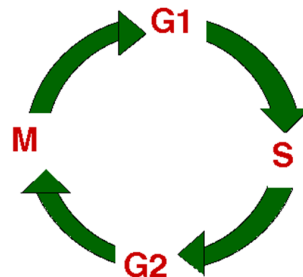
# CELL CYCLE AND MITOSIS

Jan 13-15:43

## Cell Cycle

**The Cell Cycle has 4 Phases:**

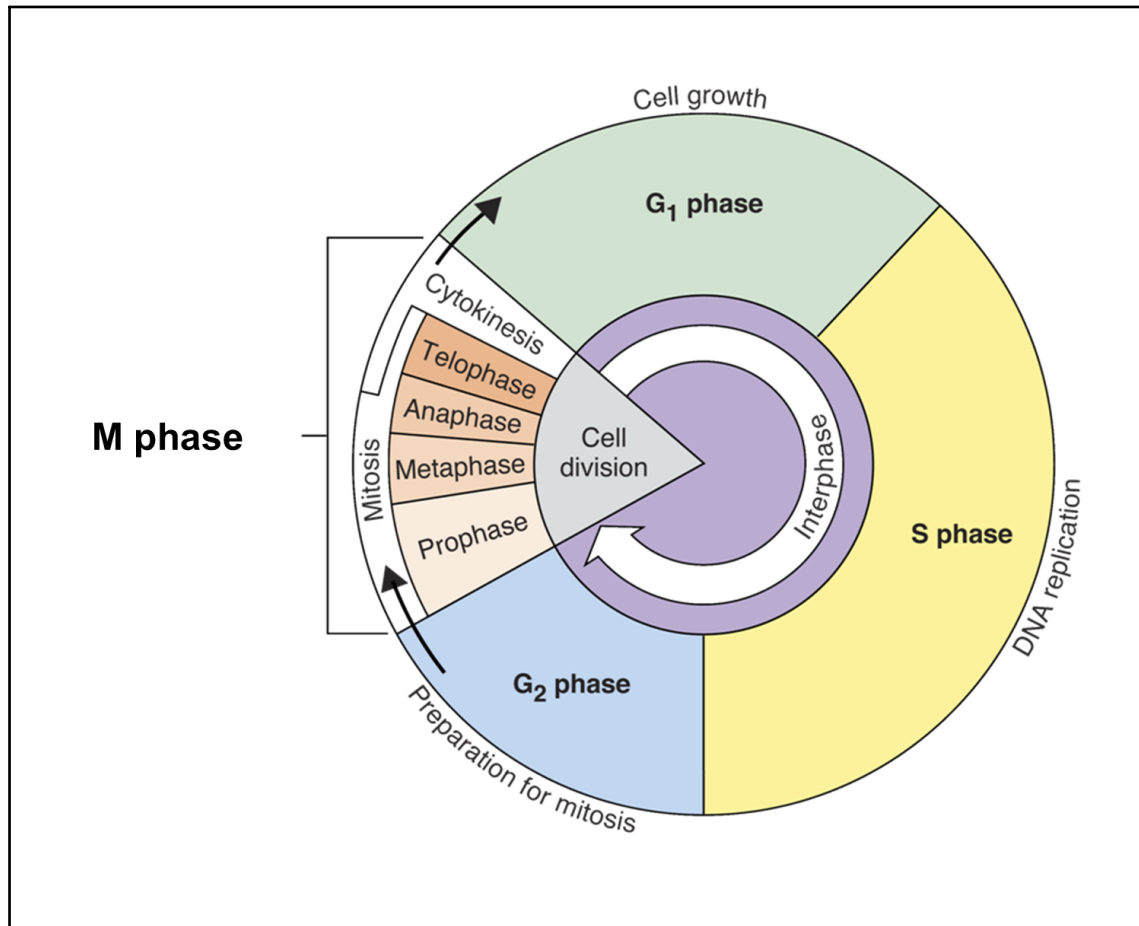
- **Gap 1 (G1)**
  - typical cell growth and metabolism
- **S Phase (S)**
  - DNA Replication
- **Gap 2 (G2)**
  - Centrioles Replicate
  - Protein synthesis
- **M Phase (M)**
  - Mitosis phase / cell division occurs



Cell Cycle Animation



Oct 23-9:15 PM

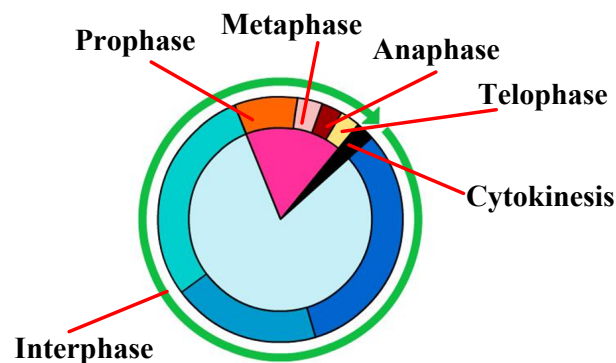


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## The cell cycle

**Interphase** - consists of the G<sub>1</sub>, S, and G<sub>2</sub> stages. It is the longest event of the cell cycle. When a cell can no longer maintain homeostasis it must divide.

**M phase** - comprised of: Prophase, Metaphase, Anaphase, Telophase, and Cytokinesis



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## G1 Phase - Growth

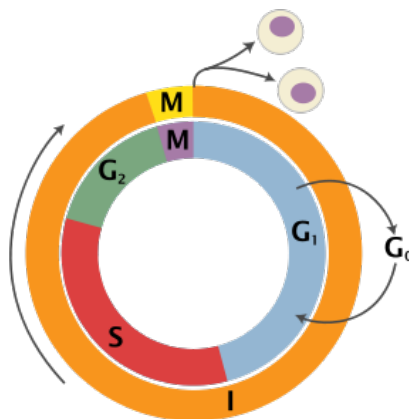
- Major period of cell growth
  - new organelles are synthesized (to do this the cell needs to engage in a high level of protein synthesis)
- A rapidly dividing (every 24 hrs) human cell will spend 9 hours in G1 Phase.
- A cell can pause in G1 phase before entering the S phase. This pause is known as the G0 phase. Before a cell can divide again it must re-enter the cell cycle in the S phase.

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## Gap 0 Phase

- Some cells don't replicate their centrioles and lose their ability to divide.

Ex. Neurons of the Spinal Cord and Brain Cells



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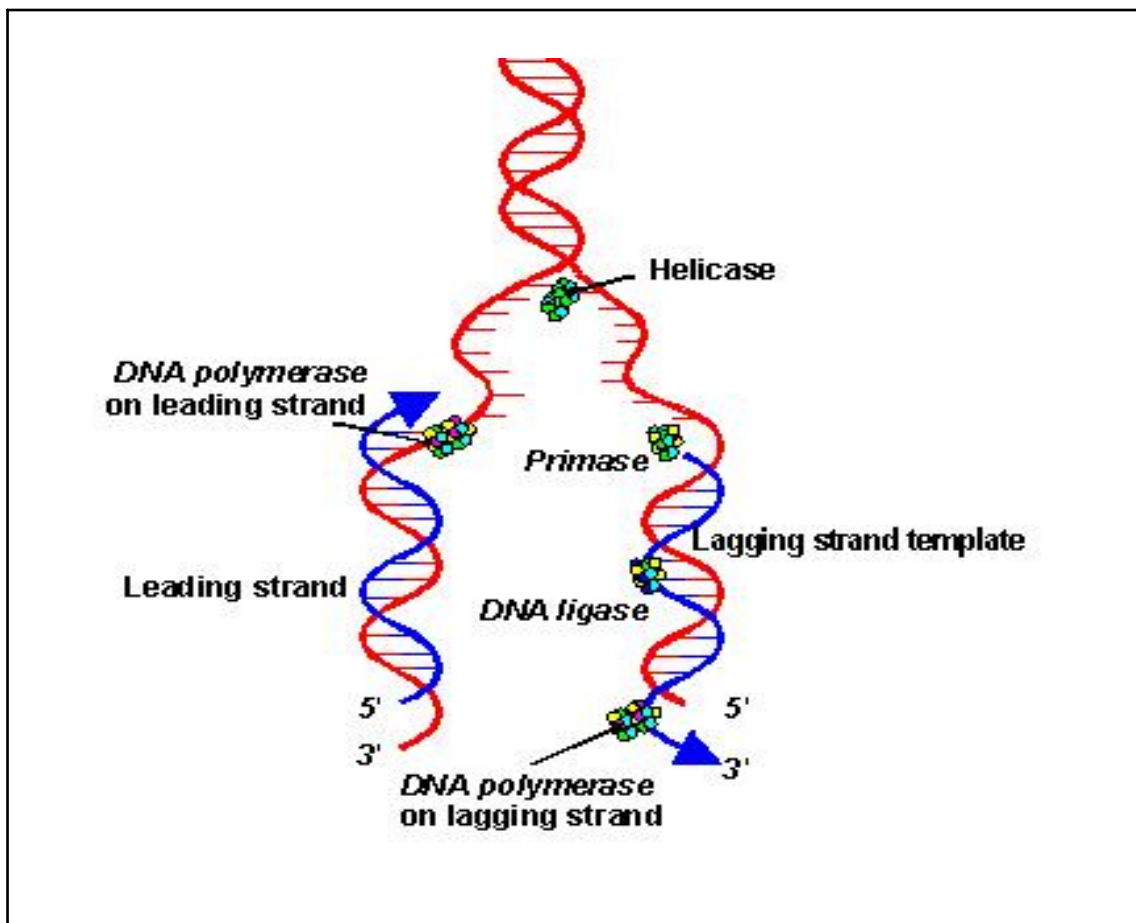
## S Phase - DNA Replication

An enzyme called **Helicase** causes the hydrogen bonds that hold DNA together to break or 'unzip' creating 2 single strands

The **DNA Polymerase** allows free floating nucleotides (from your food) within your nucleus to attach to each single strand of DNA.

DNA is replicated (copied) creating two identical strands of DNA!

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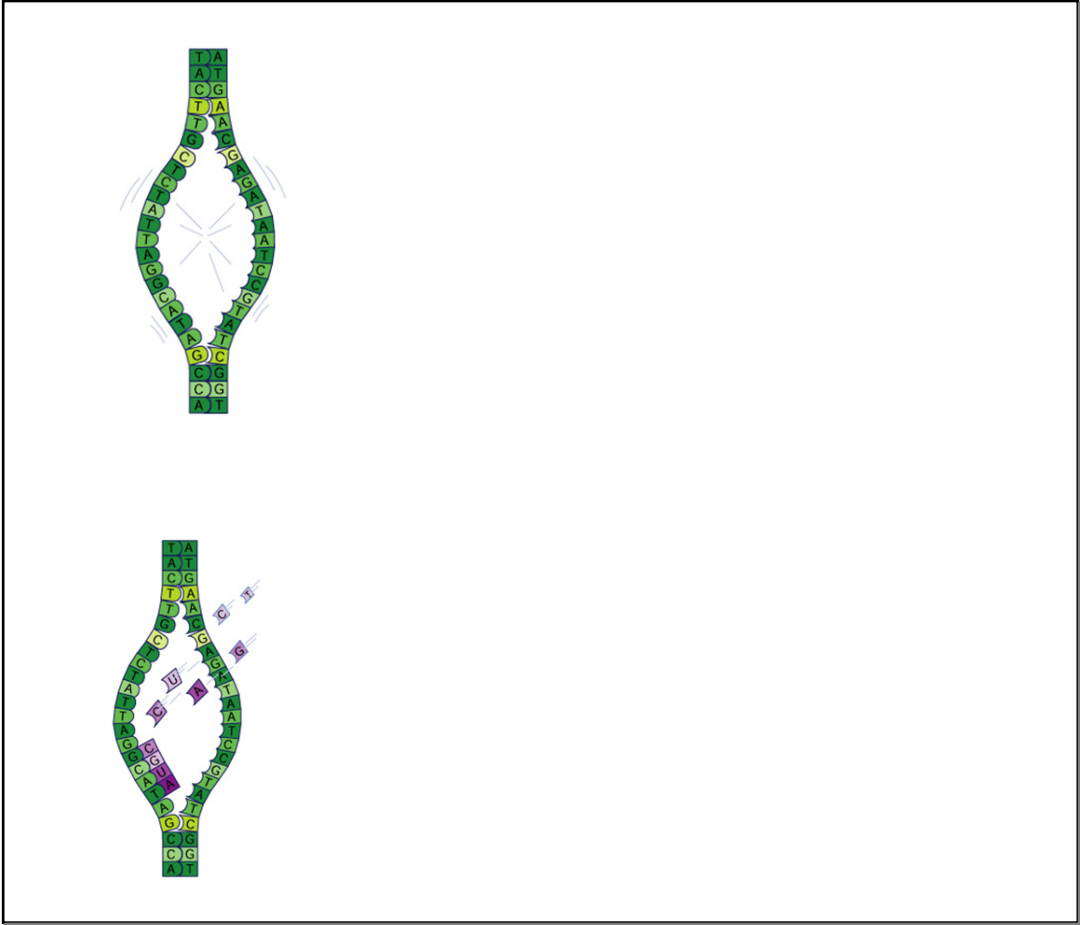


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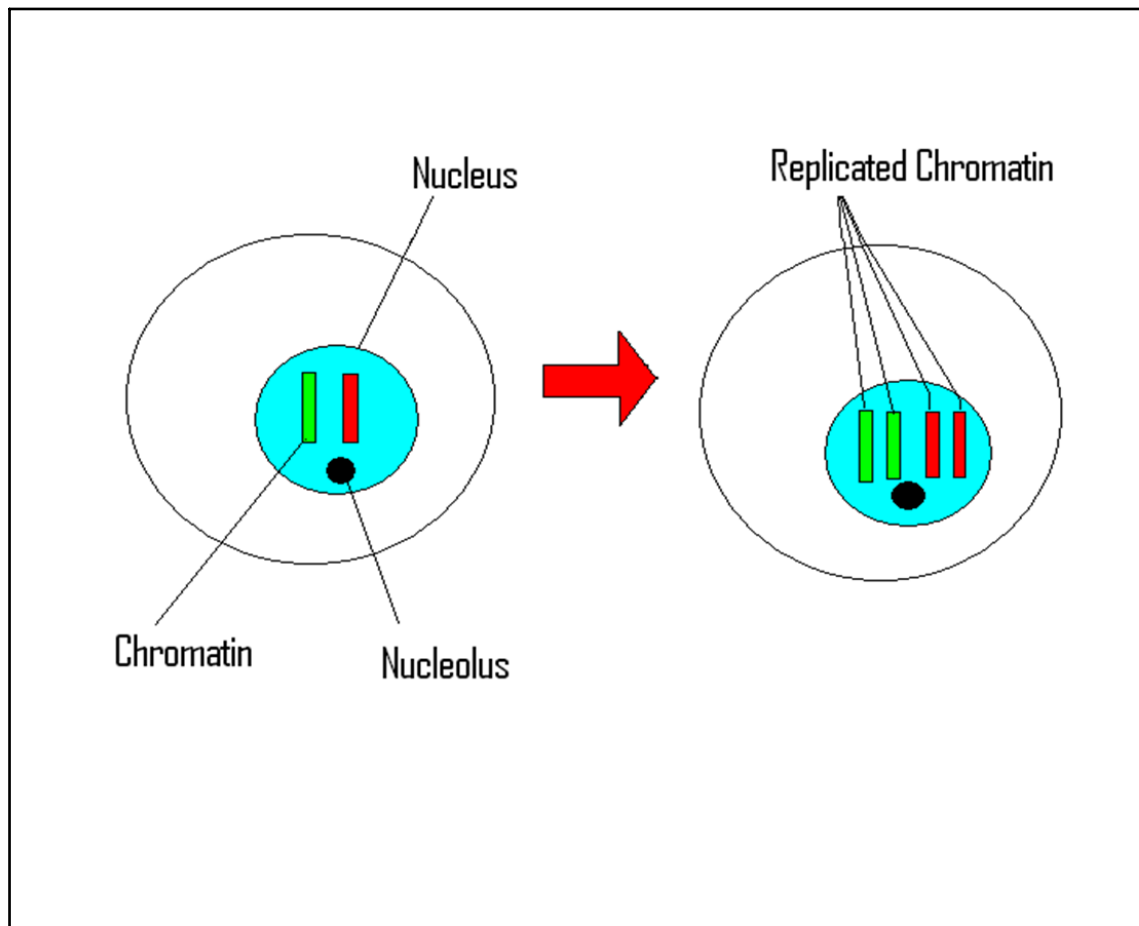
# DNA replication

- 1 Parent DNA molecule; two complementary strands of base-paired nucleotides.
- 2 Parental strands unwind and separate at several points along the DNA molecule, forming replication forks.
- 3 Each parental strand provides a template that attracts and binds complementary bases, A with T and G with C.
- 4 Sugar-phosphate backbone of daughter strands closed. Each new DNA molecule consists of one parental and one daughter strand, as a result of semiconservative replication.

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Oct 23-10:02 PM



Oct 31-6:29 PM

## DNA Replication

1. Draw a DNA triplet with the base sequence ATG on the left side. Make the 5' the top left.

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2. Separate the original DNA strands.
3. With different Colors, show the attachment of free floating nucleotides.

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### DNA Replication Questions

1. Where do the free-floating nucleotides come from?



2. How \_\_\_\_\_s compare?



3. What happens if there is a mistake made during replication?



4. How many chromosomes does a human somatic cell have at the end of DNA replication?



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## Replication



## Replication Video 1



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## **G<sub>2</sub> Phase - Growth**

- Organelles replicate in preparation for cell division.
- DNA is also checked for errors before entering into cell division.
- In human cells this phase generally takes 4 - 5 hours.

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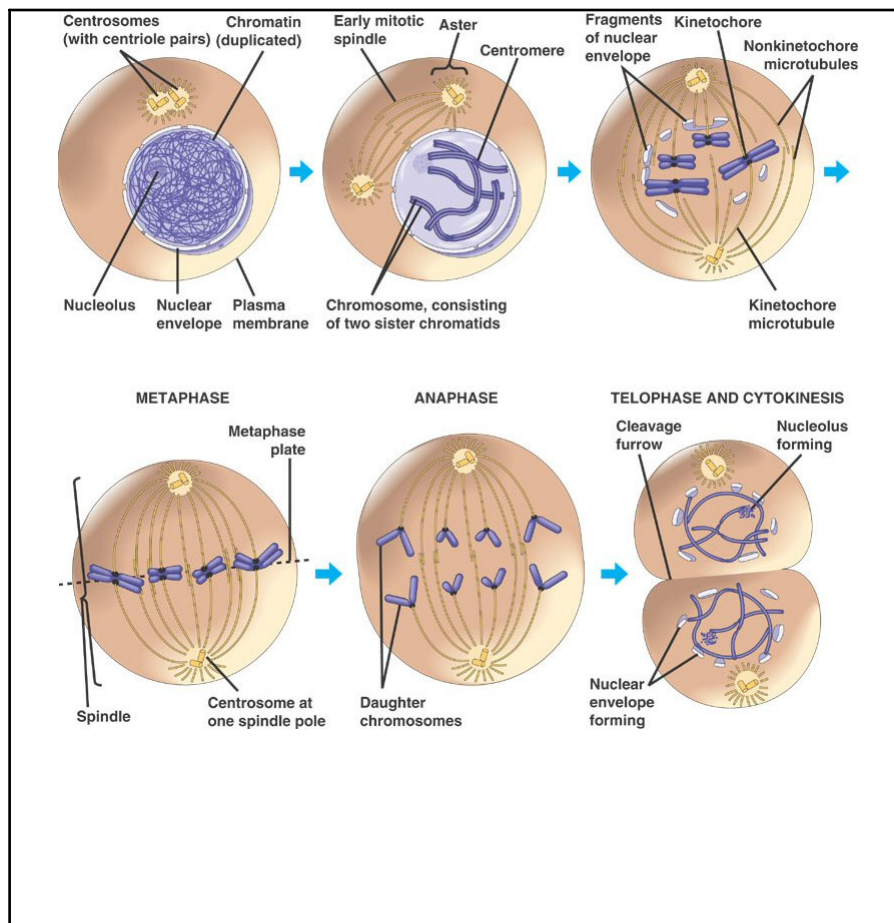
# MITOSIS

Mitosis is the division of the cell's nucleus

There are 4 main events/phases that make up mitosis:

- Prophase
- Metaphase
- Anaphase
- Telophase

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Nov 2-11:23 AM

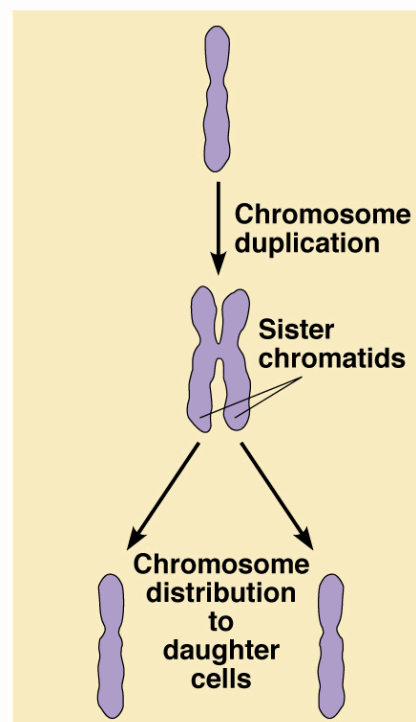
## Importance of Mitosis

1. Method of reproduction for all single celled organisms
2. Allows us to regenerate cells (tissue), repair cuts and bone breaks...
3. Growth - one cell to trillions

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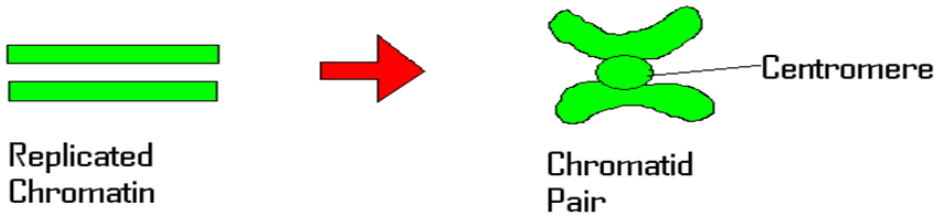
## Prophase

- Replicated chromatin from Interphase begins to shorten, thicken, and coil up to form Chromatid Pairs (Sister Chromatids)

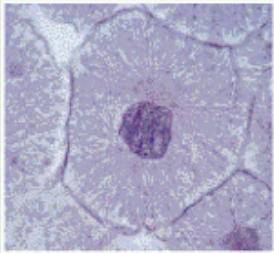


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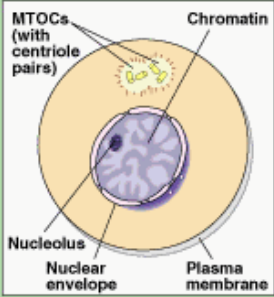
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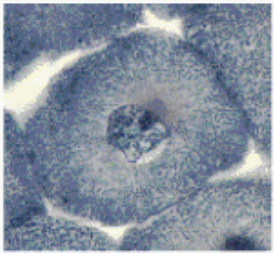
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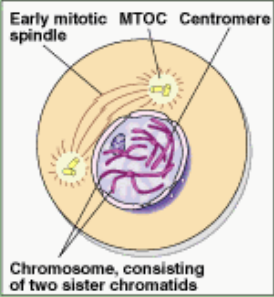
**INTERPHASE**



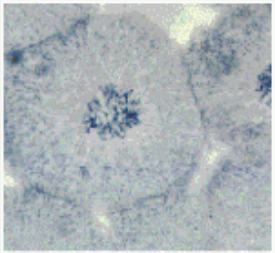
MTOCs (with centriole pairs)  
Chromatin  
Nucleolus  
Nuclear envelope  
Plasma membrane



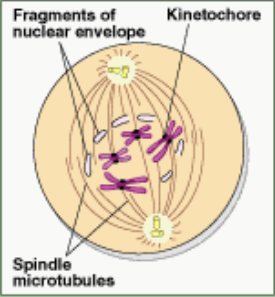
**PROPHASE**



Early mitotic spindle  
MTOC  
Centromere  
Chromosome, consisting of two sister chromatids



**PROPHASE**

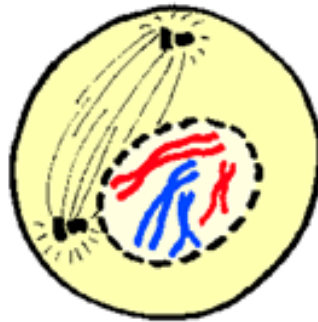


Fragments of nuclear envelope  
Kinetochore  
Spindle microtubules

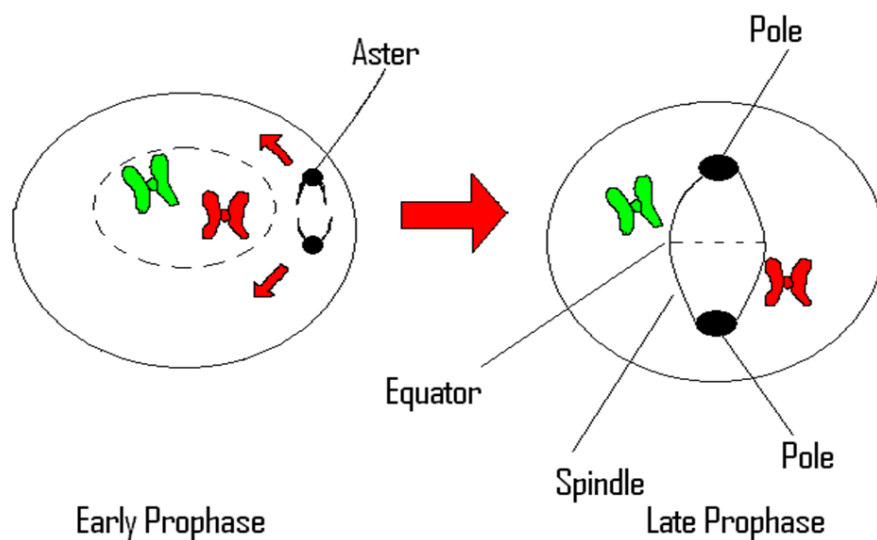
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- Nucleolus and the Nuclear membrane disappear
- Paired centrioles split apart and begin to move to opposite poles (ends) of the cell.



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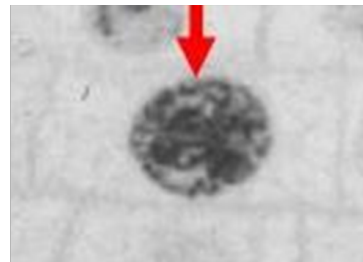
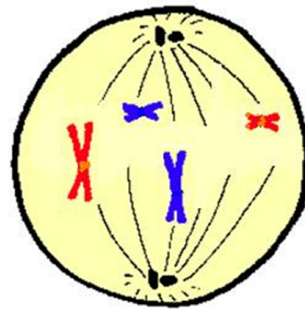
Plant cells don't have centrioles yet these spindle fibers still somehow form???

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## Late Prophase

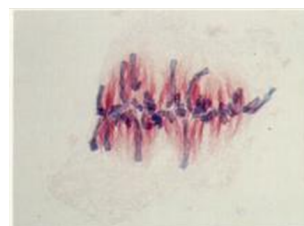
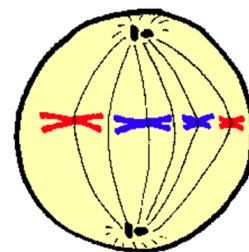
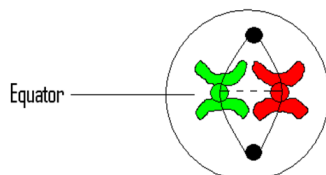
- Centrioles have reached opposite poles of the cell
- Protein fibers begin to radiate from each centriole. These structures are also called Asters.
- Chromatid pairs float throughout the cytoplasm



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## Metaphase

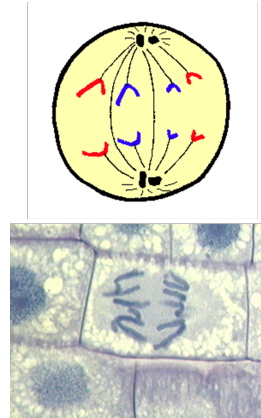
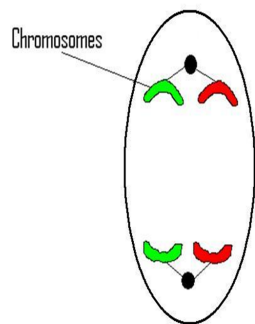
- The shortest phase of the cell cycle.
- Chromatid pairs align at the equator of the cell



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## Anaphase

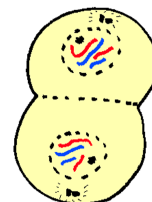
- Centromere splits and chromatid pairs separate
- Spindle fibers begin to contract and drag the single Chromosomes to opposite sides of the cell



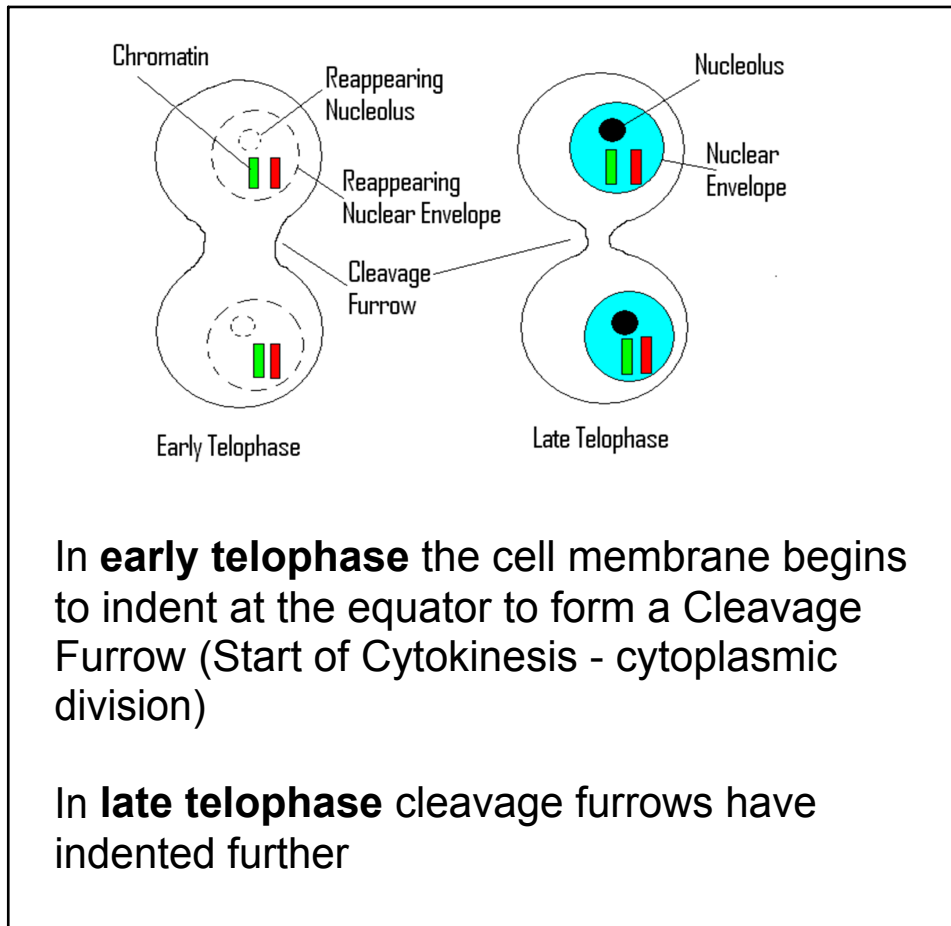
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## Telophase

- Final stage of mitosis
- Chromosomes reach the poles and begins to uncoil to form chromatin.
- Spindle fibers disappear, nuclear envelope and nucleolus begin to re-appear.



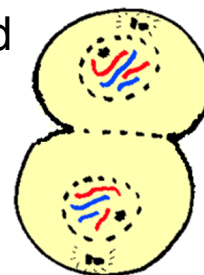
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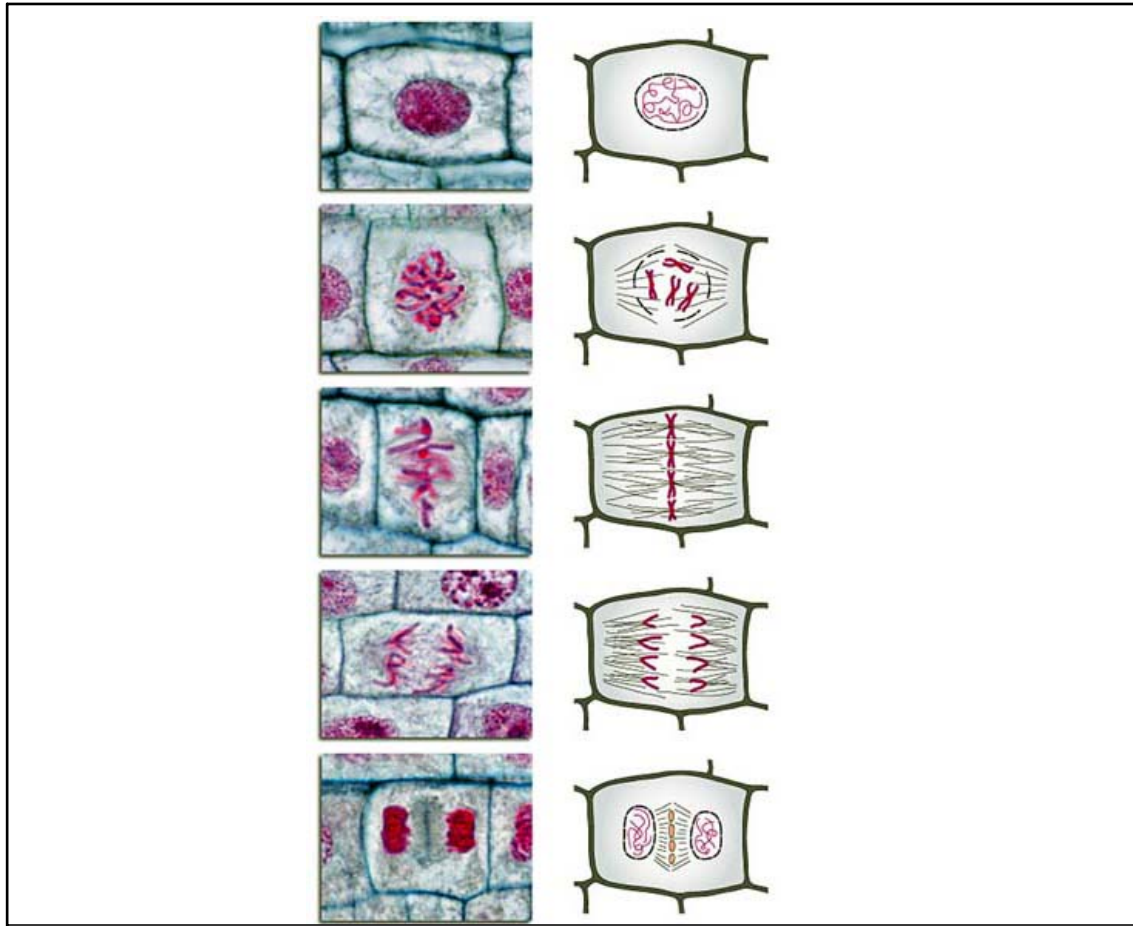
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## Late Telophase

- Cytoplasm division is completed
- The 'Mother' cell splits into 2 identical 'Daughter' cells in a process called Cytokinesis



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Nov 2-11:25 AM

MITOSIS IS NOW OVER



Oct 31-8:12 PM

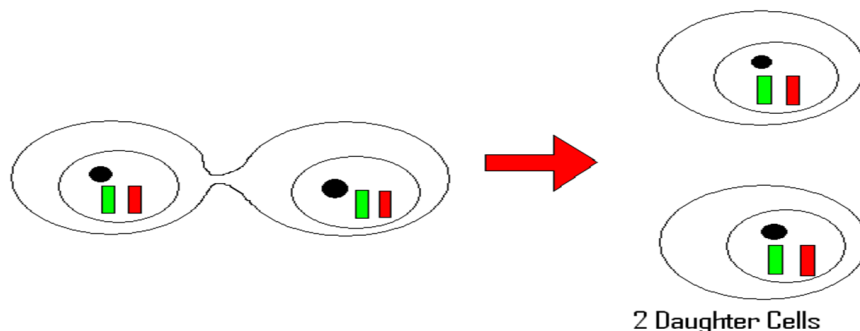
## Cytokinesis

- Refers to the division of the cytoplasm to produce 2 genetically identical daughter cells.
- Animal and Plant cell's achieve cytokinesis differently.

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### Animal Cell Cytokinesis

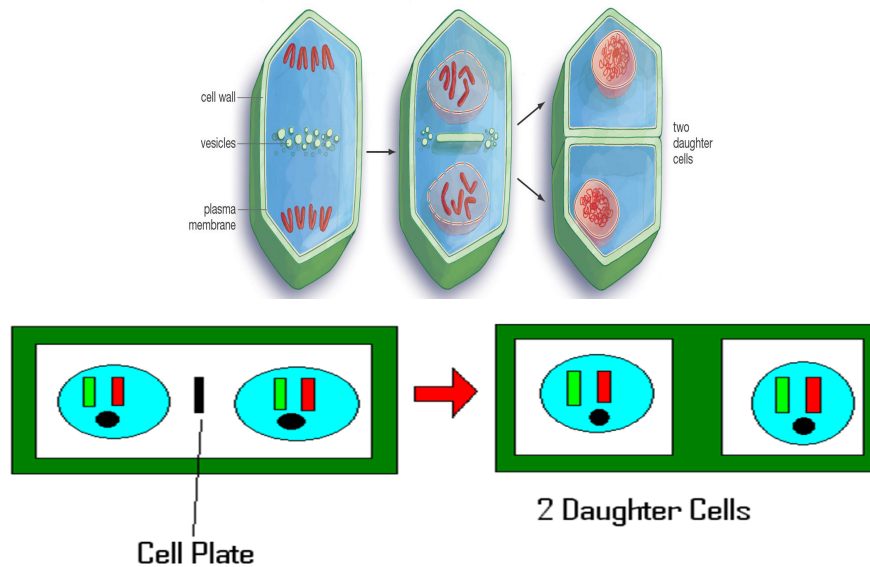
- divide from the outside by forming cleavage furrows.
- the cleavage furrow eventually pinches off in the middle



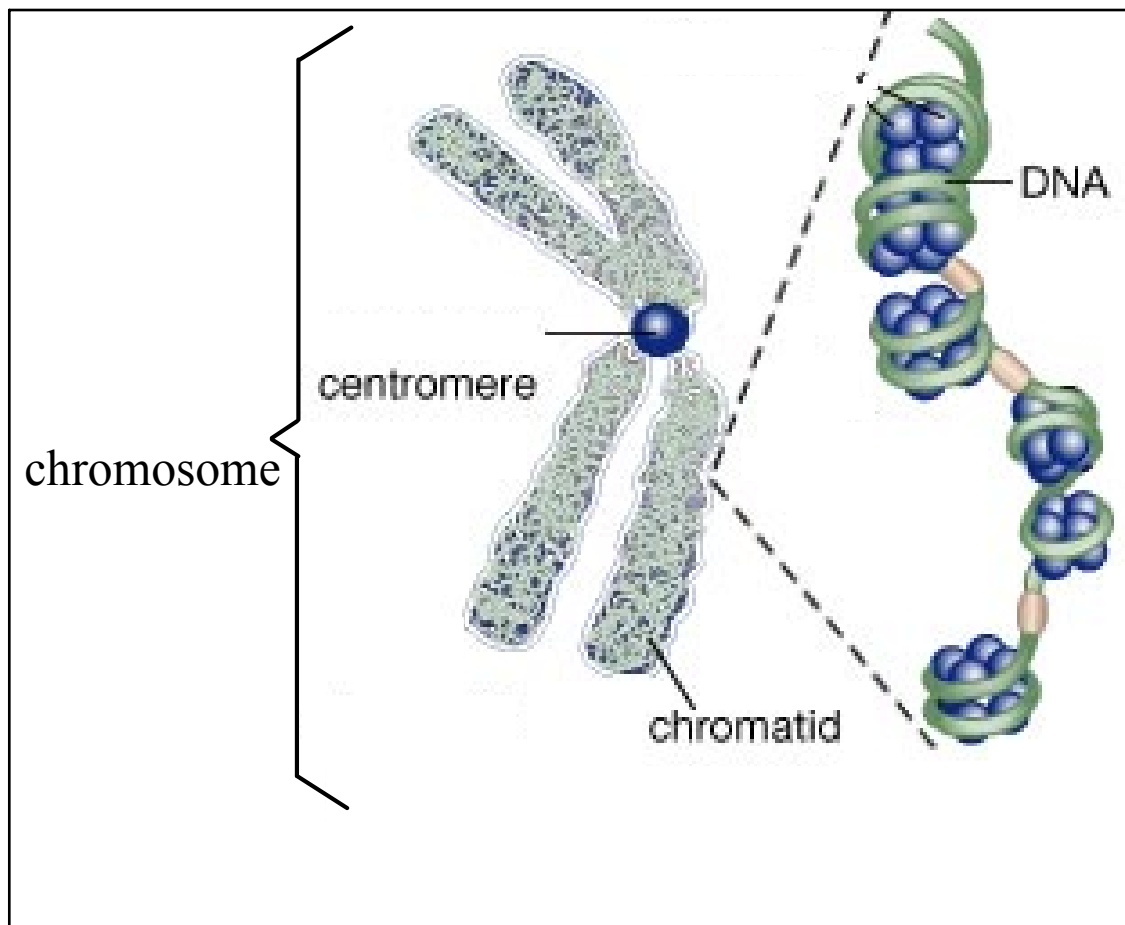
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## Plant Cell Cytokinesis

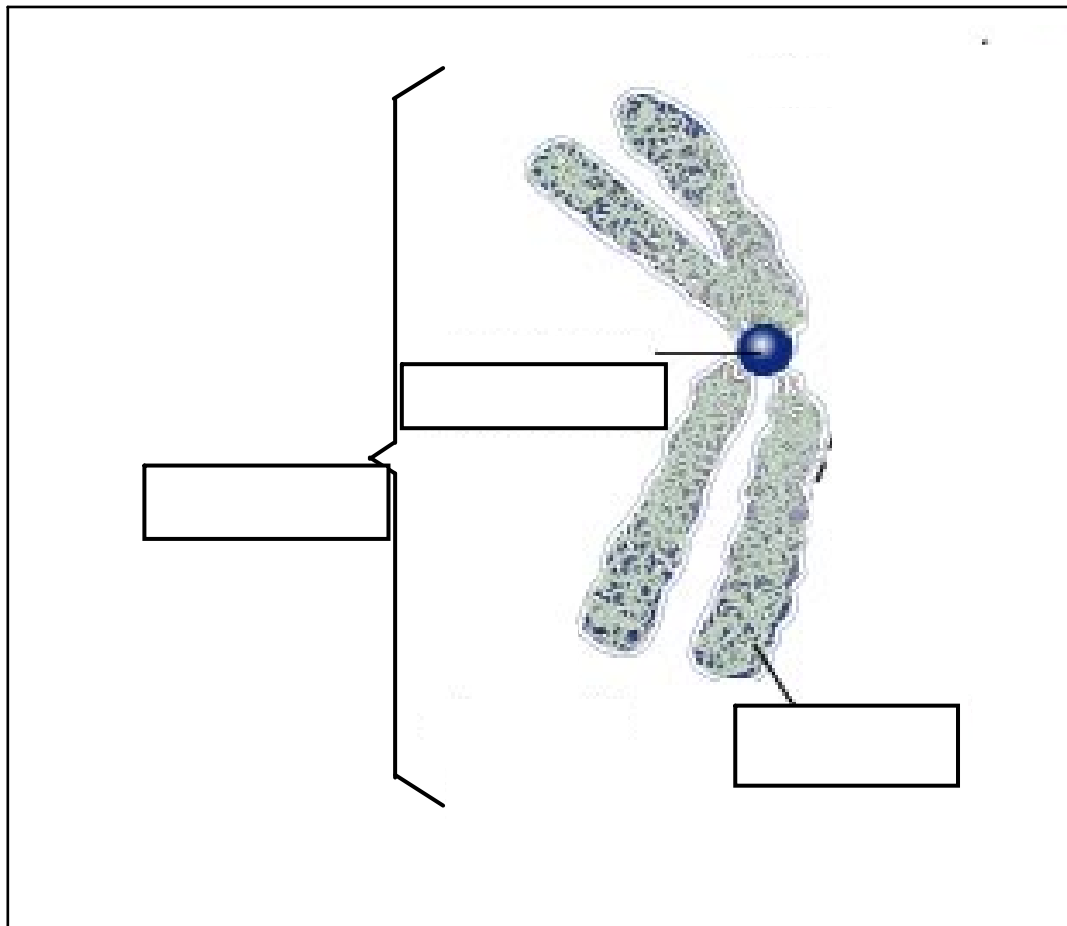
- divide from the inside out through the formation of a cell plate



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May 10-16:57



May 10-16:57

Haploid -

Diploid -

Centromere -

Chromatid -

Chromosome -

Interphase -

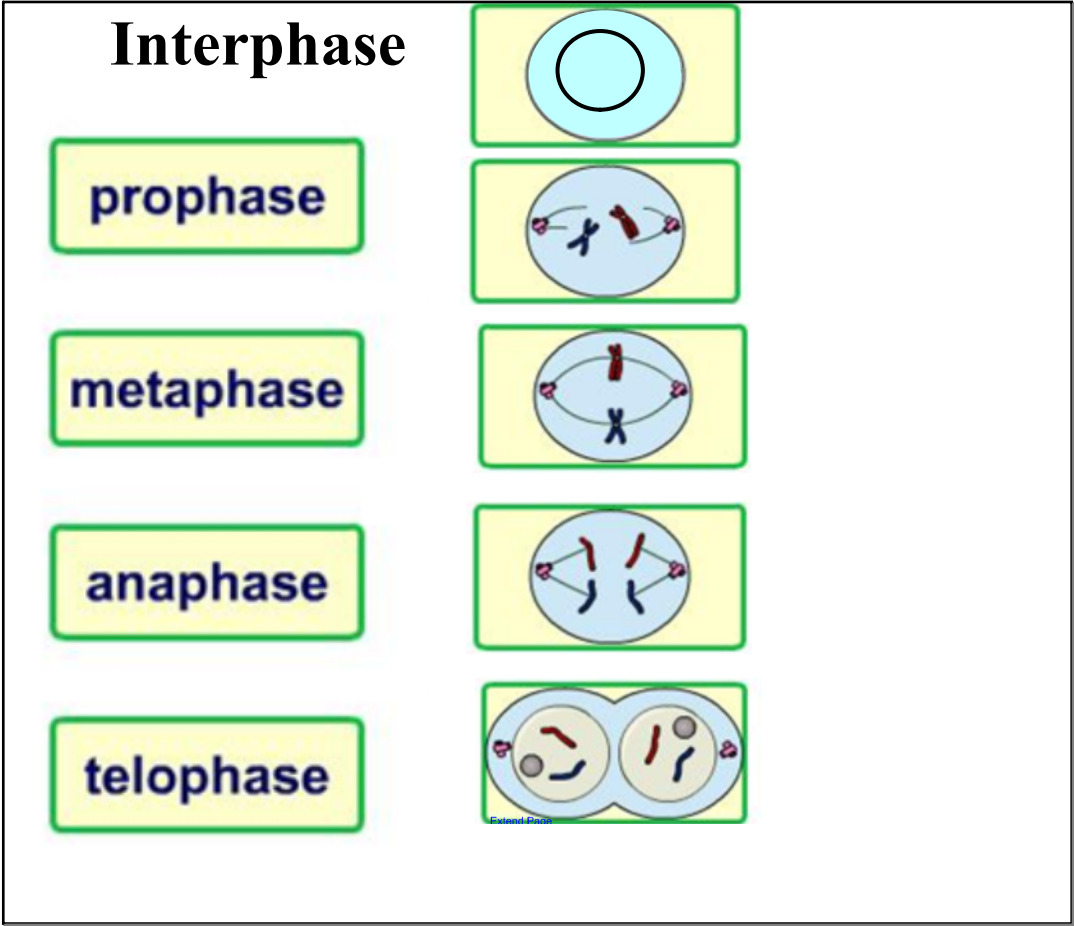
Prophase -

Metaphase -

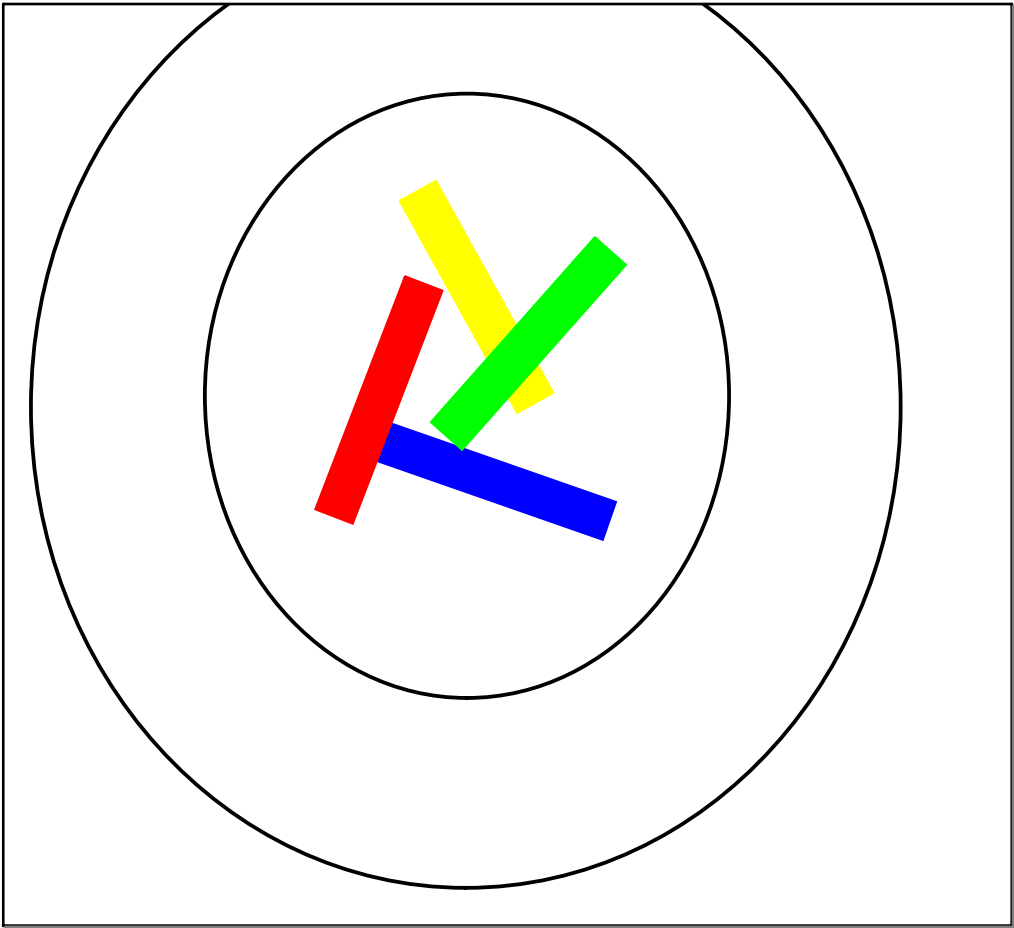
Anaphase -

Telophase -

May 10-17:05

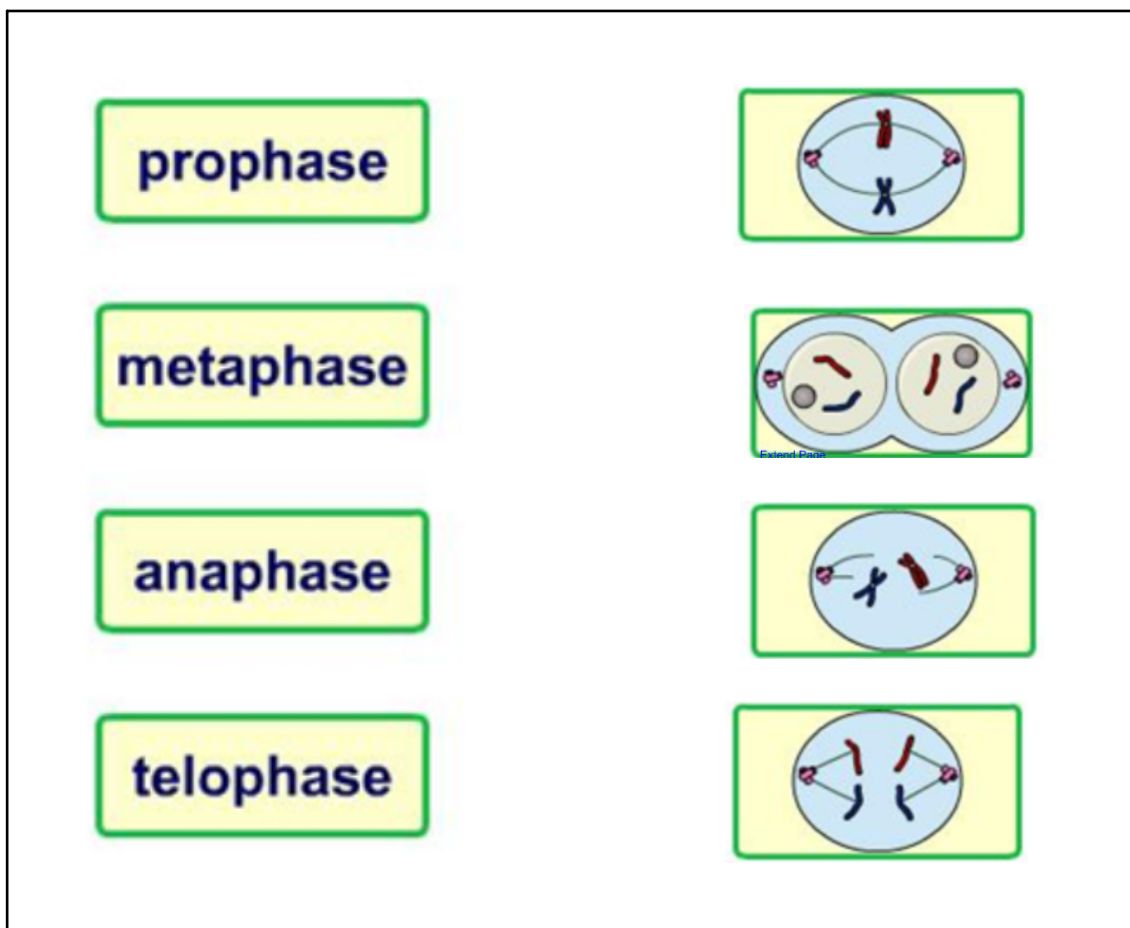


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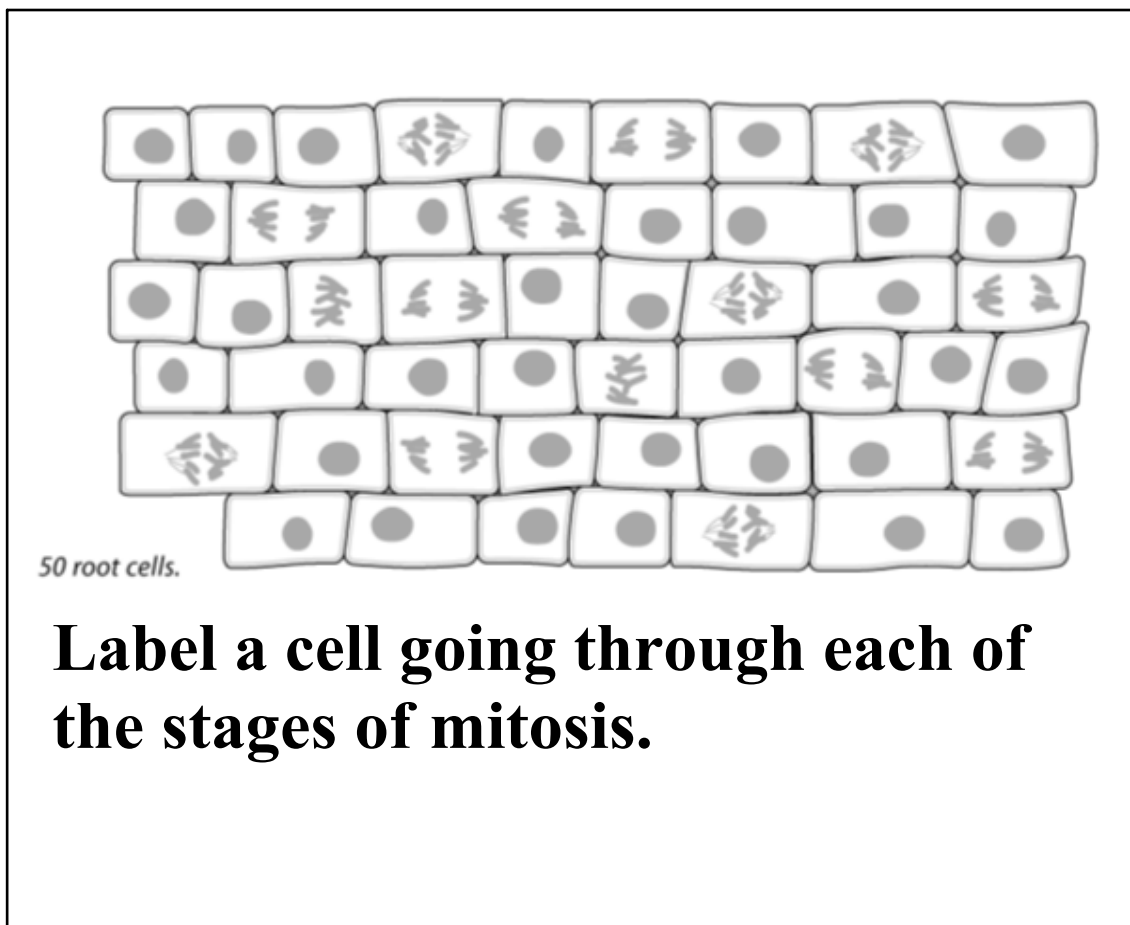


May 10-17:10





Jan 13-15:48



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Prophase, Metaphase, Anaphase, Telophase, Interphase

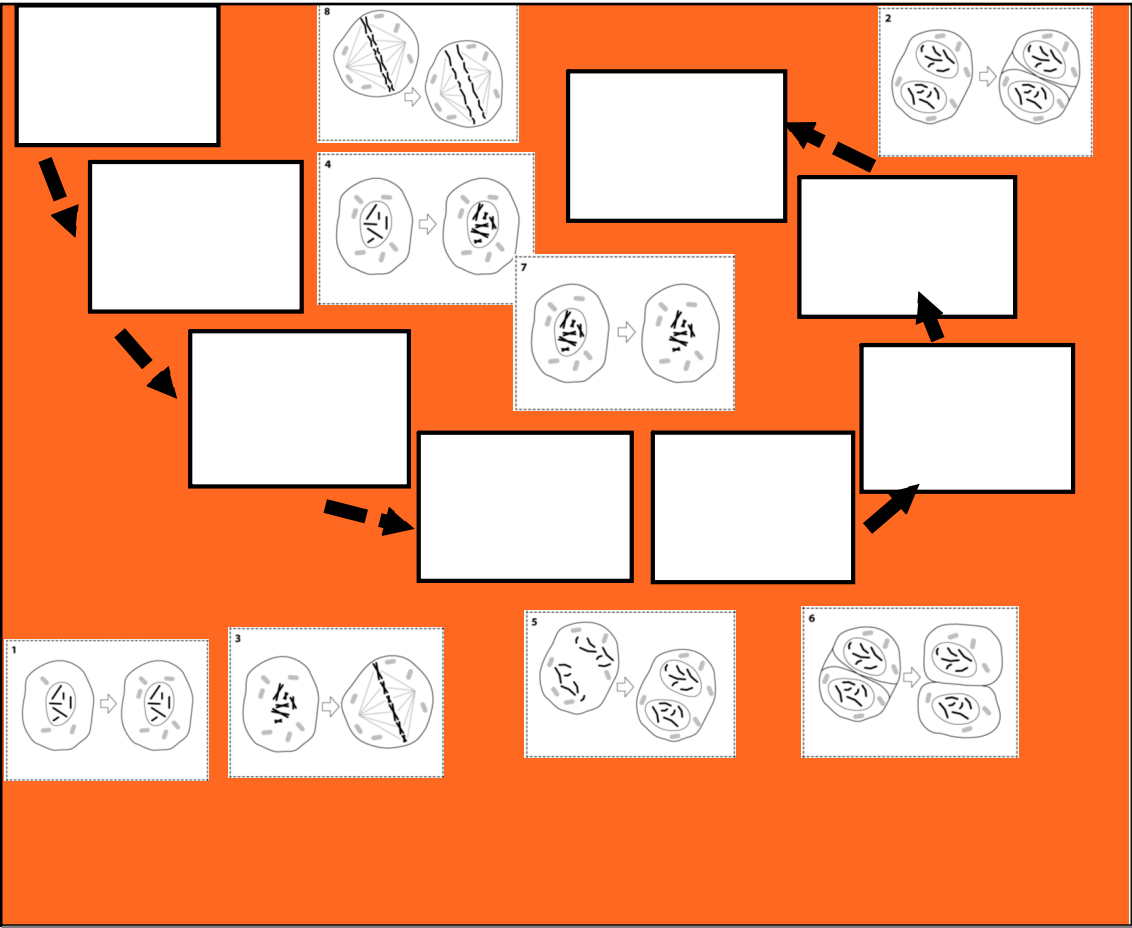
Identifying the stages of the cell cycle

A B C D E

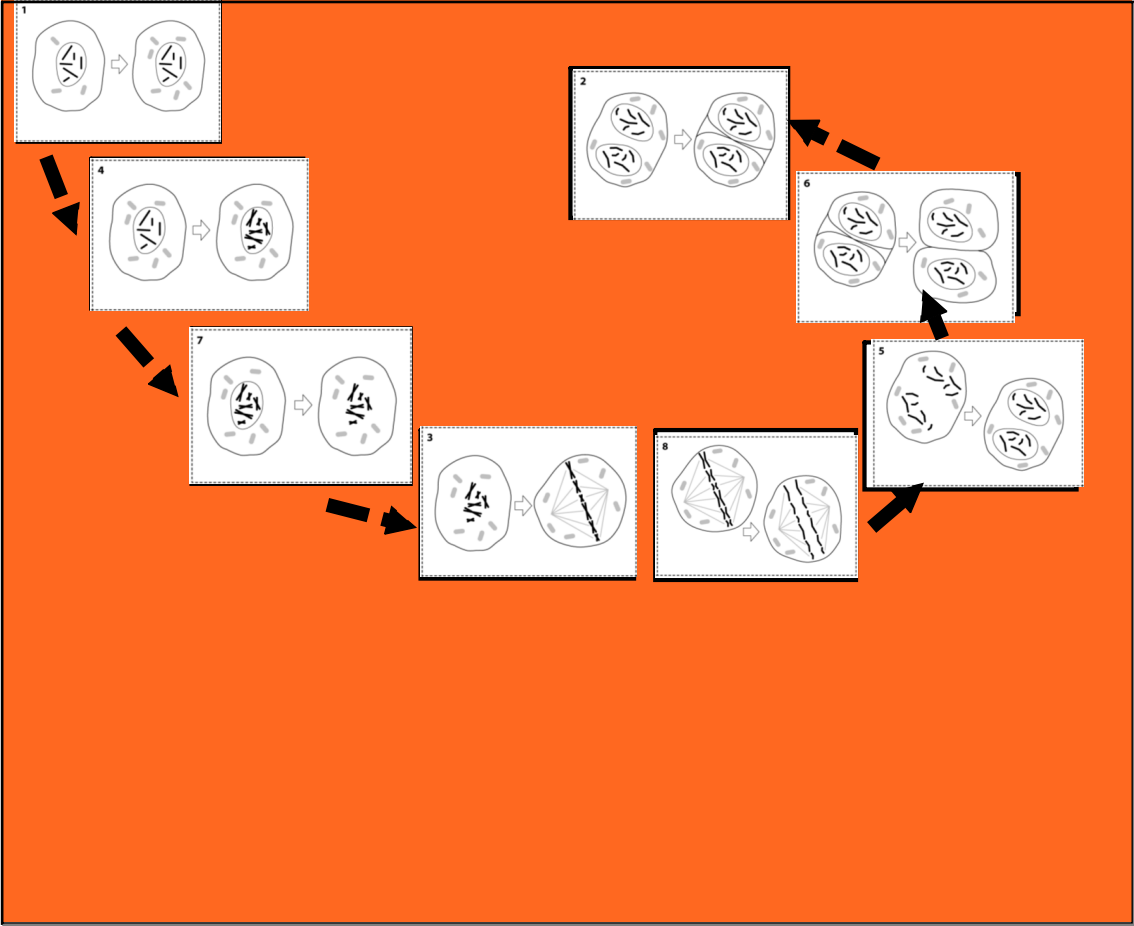
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